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Distribution and Density of Marine Birds and Mammals along the Kenai Fjords National Park Coastline - March 2010

Southwest Alaska Network Inventory and Monitoring Program

Natural Resource Technical Report NPS/SWAN/NRTR—2011/451

ON THE COVER
M/V Pukuk
Photograph by: Laura Phillips, Kenai Fjords National Park

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May 2011

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

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Coletti, H. A. J. L. Bodkin and G. G. Esslinger. 2011. Distribution and density of marine birds and mammals along the Kenai Fjords National Park coastline - March 2010: Southwest Alaska Network Inventory and Monitoring Program. Natural Resource Technical Report NPS/SWAN/NRTR—2011/451. National Park Service, Fort Collins, Colorado.

NPS 953/107696, May 2011

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Abstract

From March 21, 2010 to March 24, 2010, a winter marine bird and mammal skiff-based survey along the coast of Kenai Fjords National Park (KEFJ) was completed. This was the second winter survey completed for KEFJ since 2008. The primary objectives of the SWAN winter surveys are to characterize the species composition, density and distribution of the over-wintering marine ducks prior to their migration to breeding grounds. Seasonal differences in species composition, distribution and density of other marine birds and mammals are also documented. The overall design calls for the sampling of the same transects during both the winter and summer surveys if safe and appropriate conditions allow. The 2010 survey took approximately four days to complete with a crew of six. The most common birds observed on the nearshore transects were the Barrow's goldeneye (29.35/km^2, SE=9.24) and harlequin duck (29.30/km^2, SE=4.72). Harlequin ducks tended to be more evenly distributed along the coastline while Barrow's goldeneye tended to be observed in less exposed areas along the coast and in larger groups. In contrast, the most abundant marine bird in KEFJ summer surveys is the Glaucous-winged gull, while Barrow's goldeneye are nearly absent along the KEFJ coast. The most common marine mammal was the harbor seal (6.75/km^2, se=2.93) followed by the sea otter (3.59/km^2, se=0.90, adults and pups). Densities of harbor seals and sea otters in the summer were similar to the winter estimates.

Acknowledgments

The National Park Service, SWAN, KEFJ, Ocean Alaska Science and Leaning Center (OASLC) and the USGS Alaska Science Center supported this work. We would like to recognize the exceptional cooperation by the staff of KEFJ, USGS and SWAN as well as volunteers. In particular, we'd like to thank Declan Troy (volunteer), Tom Dean (volunteer), Michael Shephard (SWAN), Laura Phillips (KEFJ) and Brooke McFarland (KEFJ) for their field assistance. Thank you to Mark Kansteiner and Fritz Klasner for their logistical support and to Peter Armato for fiscal support through OASLC. Thank you also to Bill Choate for his skilled operation of the R/V Pukuk in KEFJ and incredible patience as we waited for a weather window. Thank you to Robin Corcoran, USFWS, Gary Drew, USGS, Karen Oakley, USGS and Laura Phillips, NPS for their thoughtful reviews.

Introduction

Marine birds and mammals are sensitive to variation in marine ecosystems. Our focus is on nearshore marine bird and mammal monitoring because these relatively abundant species are trophically linked to the nearshore food web. This food web consists of kelps and seagrasses, that contribute substantially to primary productivity, and benthic invertebrates such as clams, mussels and snails. When consumed, these invertebrates can transmit energy to higher trophic level fishes, birds and mammals. Marine bird species of focus for the nearshore food web under the National Park Service Southwest Alaska Network (SWAN) Vital Signs Inventory and Monitoring (I&M) Program (http://science.nature.nps.gov/im/units/swan/) include: black oystercatchers (*Haematopus bachmani*), cormorants (*Phalacrocorax spp.*), glaucous-winged gulls (*Larus glaucescens*), goldeneyes (*Bucephala spp.*), harlequin ducks (*Histrionicus histrionicus*), mergansers (*Mergus spp.*), pigeon guillemots (*Cepphus columba*), and scoters (*Melanitta spp*.). Because other birds and mammals will be encountered, observations of all marine birds and mammals are recorded and reported.

The sea ducks and black oystercatcher were selected for focus because of their reliance on habitats and prey associated with nearshore marine communities. These species are top-level consumers of nearshore invertebrates such as mussels, clams, snails, and limpets that are being monitored under the algal and intertidal invertebrate standard operating procedure (SOP) within the SWAN I&M Program. Because these seabird species are recognized as important consumers of marine invertebrates (Draulans 1982, Marsh 1986a and b, Meire 1993, Lindberg et al. 1998, Hamilton and Nudds 2003, Lewis et al. 2007), concurrent estimates of their prey populations, provided by nearshore invertebrate monitoring, allows us to begin to understand potential causes of changes in abundance over time. Moreover, monitoring trends in abundance of the various guilds of other marine birds (e.g. pigeon guillemots, black-legged kittiwakes, and cormorants) that occupy other food webs or habitats may improve the ability to discriminate among potential causes of change in seabird populations and the nearshore ecosystem. For example, concurrent changes in sea ducks, which forage on nearshore invertebrates and pigeon guillemots that forage on small fish, may suggest a common cause(s) of change that may be independent of food.

Such an approach may provide insights related to competing hypotheses relative to cause of change within or among populations (Petersen et al. 2003). In addition many of these species, including the harlequin duck, Barrow's goldeneye, and black oystercatcher were impacted by the *Exxon Valdez* oil spill, and exhibited protracted recovery periods as a consequence of lingering oil in nearshore habitats in Prince William Sound (Andres 1999, Trust et al. 2000, Esler et al. 2000, Esler et al. 2002). These species are still listed as 'Recovering' in the 2010 Injured Resources & Services Update from the *Exxon Valdez* Oil Spill Trustee Council (*Exxon Valdez* Oil Spill Trustee Council 2010). Long-term monitoring of these species at different locations would provide increased confidence in status assessments of these populations relative to restoration and recovery from the 1989 spill. Additionally, existing data collected using comparable methods are available from other nearshore habitats in the Gulf of Alaska for periods up to 20 years (Irons et al.1988, Irons et al. 2000). Long-term monitoring of these species at different locations can provide an additional spatial component increasing the likelihood of that hypotheses explaining population trends will have broad applicability.

The purpose of March marine bird surveys is to characterize the density, distribution and species composition of marine birds within the SWAN parks during late winter. Only one late winter survey had been conducted in KEFJ prior to the 2008 (3/11/2008 – 3/14/2008) SWAN survey- a survey before and after oil reached KEFJ (*Exxon Valdez* oil spill) in 1989 (Vequist and Nishimoto 1990). Additional late winter baseline data did not exist prior to the 2008 SWAN survey.

Methods

Standardized surveys of marine birds and mammals were conducted in KEFJ in March, 2010. Detailed descriptions of methods and procedures can be found in the Marine Bird and Mammal Survey SOP (Dean and Bodkin 2006) and are summarized below. The methods used to survey marine birds in the winter are the same as those methods employed during summer skiff-based surveys of marine birds and mammals.

The survey design consists of a series of transects along shorelines such that a minimum of 20% of the shoreline is surveyed. Transects were systematically selected beginning at a random starting point from the pool of contiguous 2.5-5 km transects that are adjacent to the mainland or islands, plus the lengths of transects that were associated with islands or groups of islands with less than 5 km of shoreline (Figure 1). The survey was designed using ArcGIS (ESRI, Redlands, CA).

Surveys were conducted from small vessels (5-8 m length) navigated along selected sections of coastline that represent independent transects at speeds of 8-12 knots. Transect width was 200 m and two observers searched each side of the vessel out 100 m. All marine birds and mammals within the 200 m transect width that includes 100 m ahead of, behind, and over the vessel were identified and counted. One observer navigated the skiff, and generally surveyed the offshore portion of the transect. The second observer counted birds and mammals on the shore side of the survey transect, and a third member of the team was responsible for entering observations into a computer program (dLOG2) designed specifically for these surveys (Dean and Bodkin 2006), and assisted in observations. All transects considered in this analysis were run 100 m offshore and parallel to the shoreline.

Data analysis focused on nine taxa identified as important to nearshore food webs and as important indicators of change (Dean and Bodkin 2009). Several species were also grouped into higher order taxa (e.g. cormorants) because identification to species within these groups was not always possible. Cormorant species included pelagic, red-faced, and double-crested cormorants. Scoters included surf, black, and white-winged scoters. Densities were calculated using weighted averages by transect length.

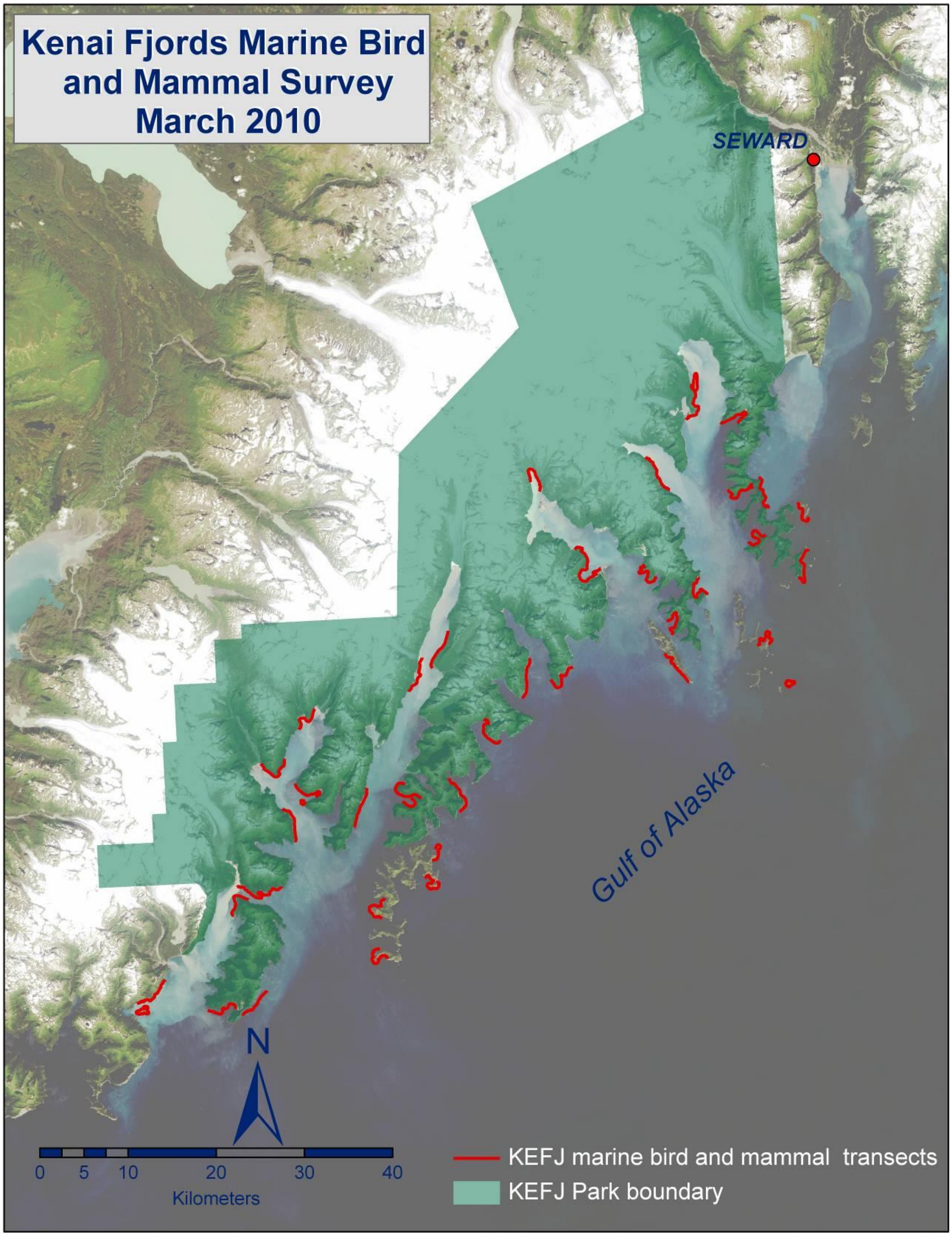

Figure 1. Nearshore marine bird and mammal transects along the KEFJ coastline.

Results

Counts of birds were made along 32 of the 38 nearshore transects that comprise a systematic sample of the entire coastline. Poor weather conditions precluded completion of the entire survey of 38 transects. Also, some portions of completed transects were not sampled due to the presence of ice (Figure 2). Sampled nearshore transect lengths ranged from 1.918 km to 6.112 km ($\bar{X}$ = 4.906 km). Transects surveyed in 2010 represent approximately 20% of the 770 km of shoreline along KEFJ, or about 157 km (34 km^2). Between March 21, 2010 and March 24, 2010 the most common birds observed on the nearshore transects were the Barrow's goldeneye (29.35/km^2, se=9.24) and harlequin duck (29.30/km^2, se=4.72) (Table 1). Harlequin ducks tended to be more evenly distributed along the coastline (Figure 3) while Barrow's goldeneye tended to occur in larger groups along less exposed areas of coast (Figure 4). The most common marine mammal was the harbor seal (6.75/km^2, se=2.93) followed by the sea otter (3.59/km^2, se=0.90, adults and pups) (Table 1 and Figure 5). Several other species of interest are mapped and reported here to illustrate relative abundance and distribution (Table 1 and Figures 6-9)

Table 1. Statistics from the nearshore marine bird and mammal surveys conducted during March of 2010 in KEFJ.

Species	# of groups observed	Min	Max	Sum	Average density (#/km^2)	SE
Barrow's goldeneye *(Bucephala islandica)*	17	1	133	891	29.35	9.24
Black-legged kittiwake (*Rissa tridactyla*)	2	1	8	14	0.45	0.35
Black oystercatcher (*Haematopus bachmani*)	3	1	1	4	0.12	0.07
Black scoter *(Melanitta nigra)*	2	2	38	66	2.24	1.58
Bufflehead *(Bucephala albeola)*	5	1	14	71	1.69	0.98
Common merganser (*Mergus merganser*)	10	1	19	96	2.97	1.06
Double-crested cormorant (*Phalacrocorax auritus*)	8	1	9	25	1.01	0.60
Glaucous-winged gull (*Larus glaucescens*)	28	1	133	636	20.40	6.91
Harlequin duck (*Histrionicus histrionicus*)	32	1	70	869	29.30	4.72
Long-tailed duck *(Clangula hyemalis)*	3	1	2	4	0.12	0.07
Pelagic cormorant (*Phalacrocorax pelagicus*)	30	1	26	277	10.10	2.50
Pigeon guillemot (*Cepphus columba*)	9	1	1	11	0.34	0.11
Red-faced cormorant (*Phalacrocorax urile*)	6	1	24	96	3.01	2.24
Surf scoter (*Melanitta perspicillata*)	15	1	70	294	10.01	3.74
Unid. cormorant (*Phalacrocoracidae sp*.)	5	1	4	9	0.34	0.20
Unid. scoter *(Melanitta spp*.)	2	1	1	2	0.06	0.04
White-winged scoter (*Melanitta fusca*)	3	2	6	10	0.34	0.22
Sea otter (adult) (*Enhydra lutris*)	23	1	13	97	3.28	0.85
Sea otter (pup) (*Enhydra lutris*)	.	.	.	11	0.31	0.12
Overall scoter	.	.	.	372	12.64	4.01
Overall cormorant	.	.	.	407	14.45	4.03

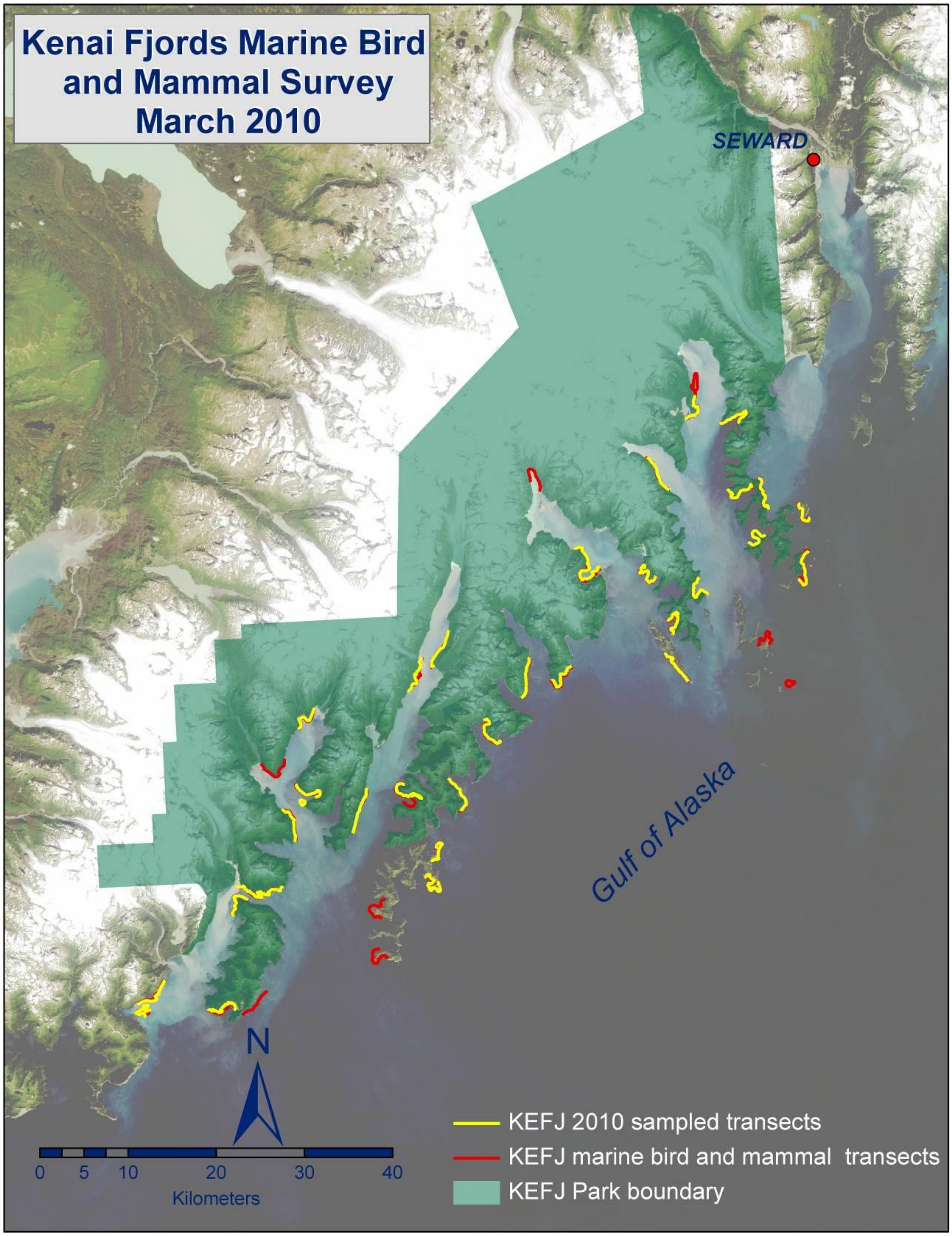

Figure 2. Nearshore marine bird and mammal transects sampled in 2010 along the KEFJ coastline, superimposed over the original survey design.

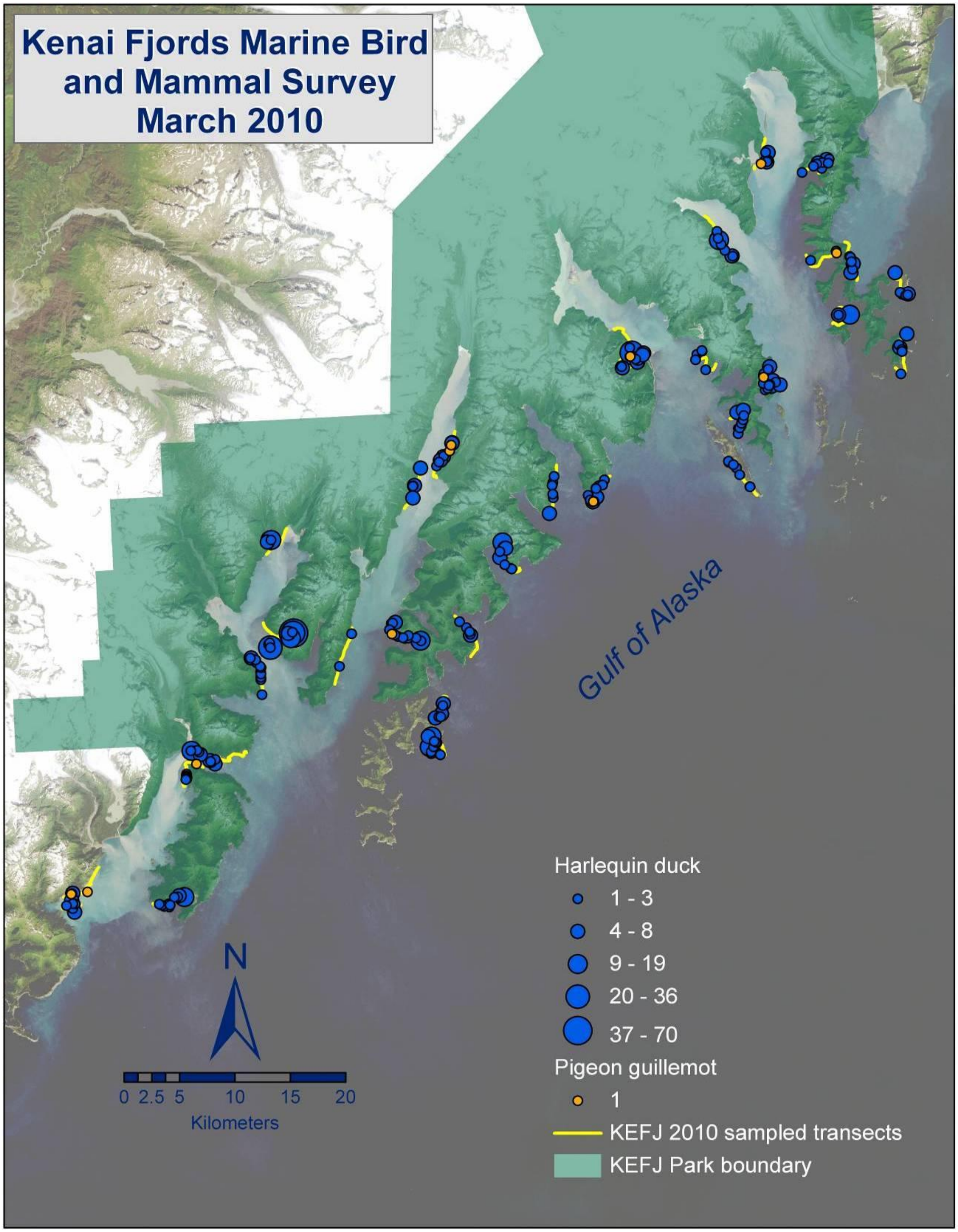

Figure 3. Harlequin duck and pigeon guillemot relative abundance and distribution along the KEFJ coastline, March 2010.

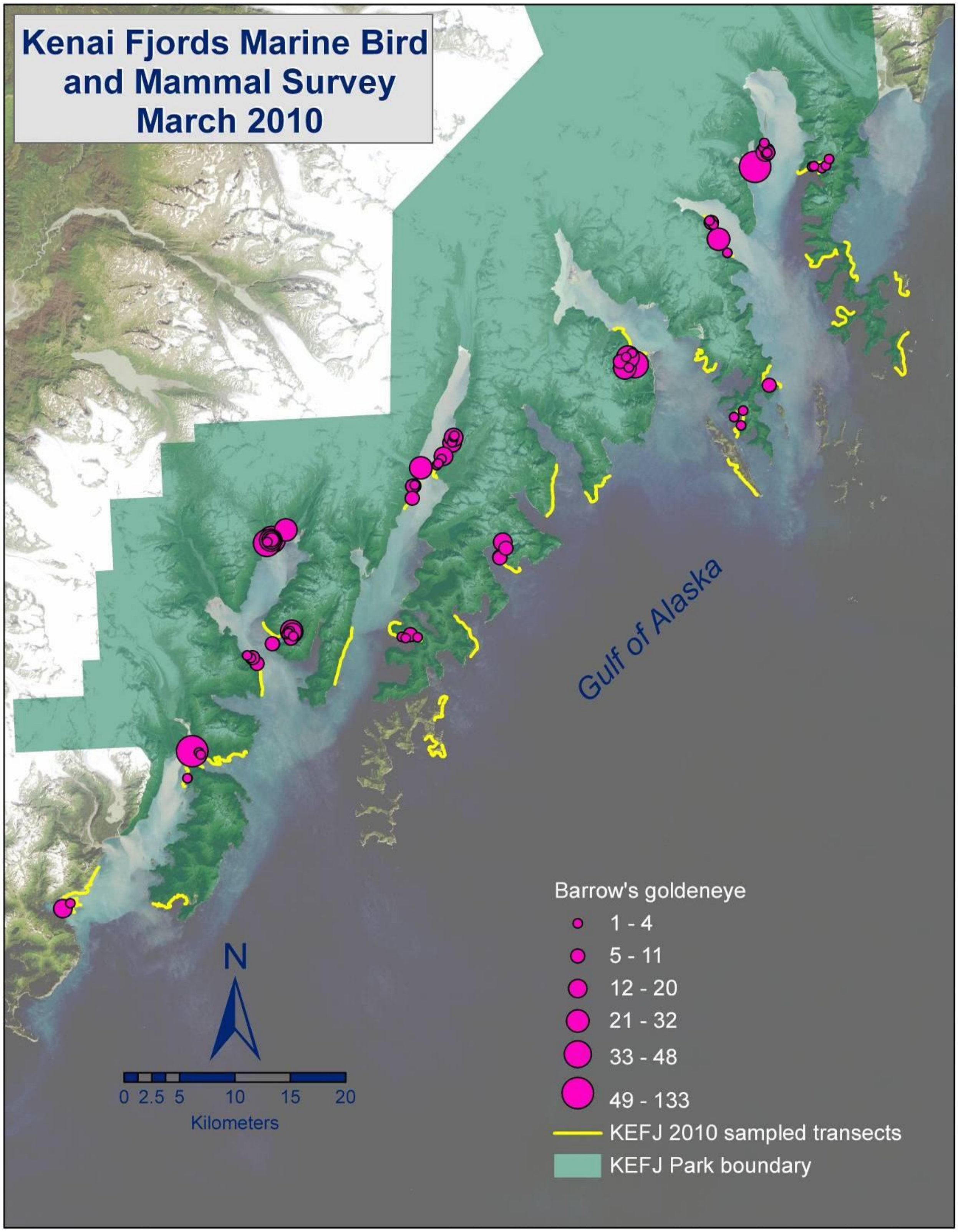

Figure 4. Barrow's goldeneye relative abundance and distribution along the KEFJ coastline, March 2010.

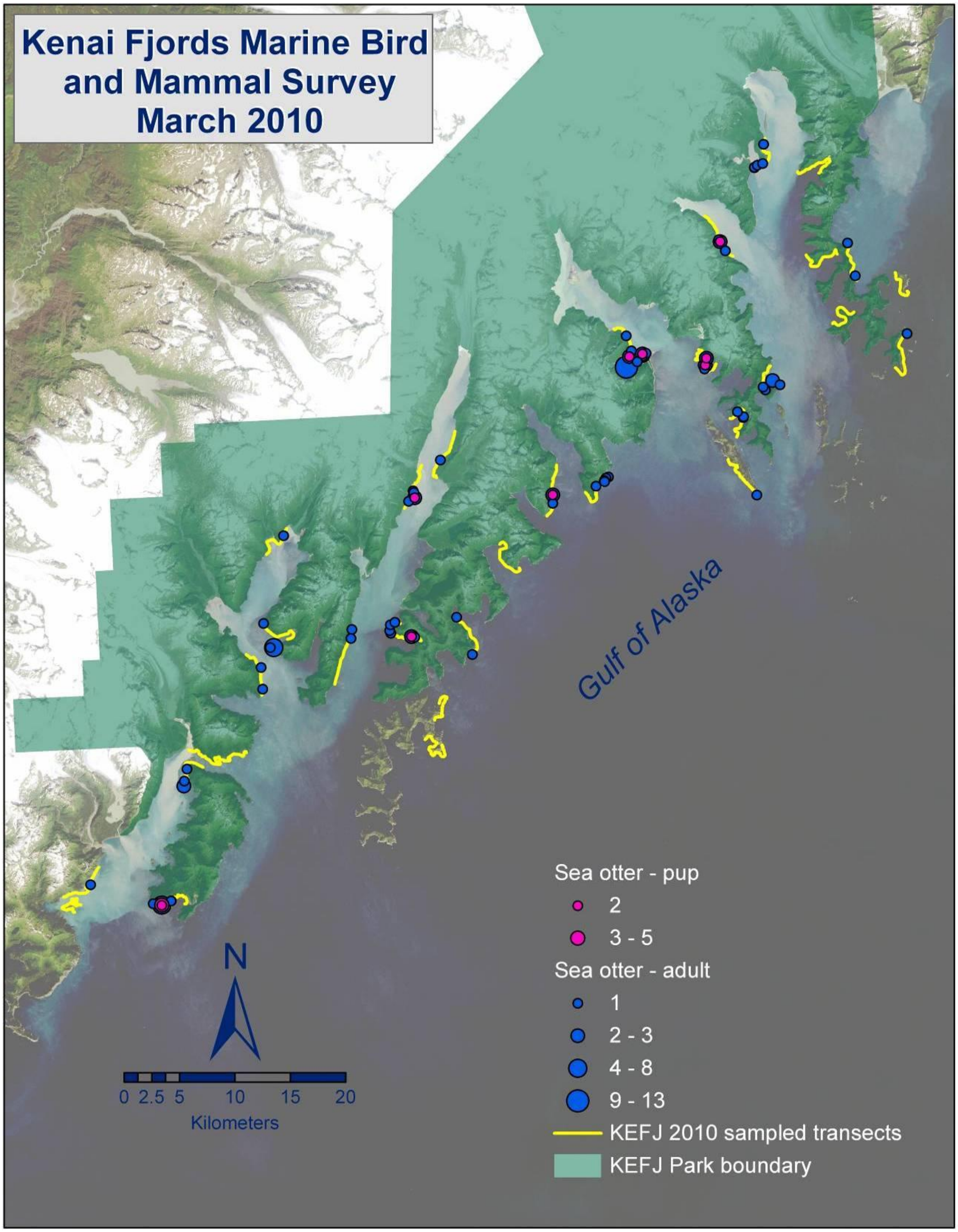

Figure 5. Sea otter adult and pup relative abundance and distribution along the KEFJ coastline, March 2010.

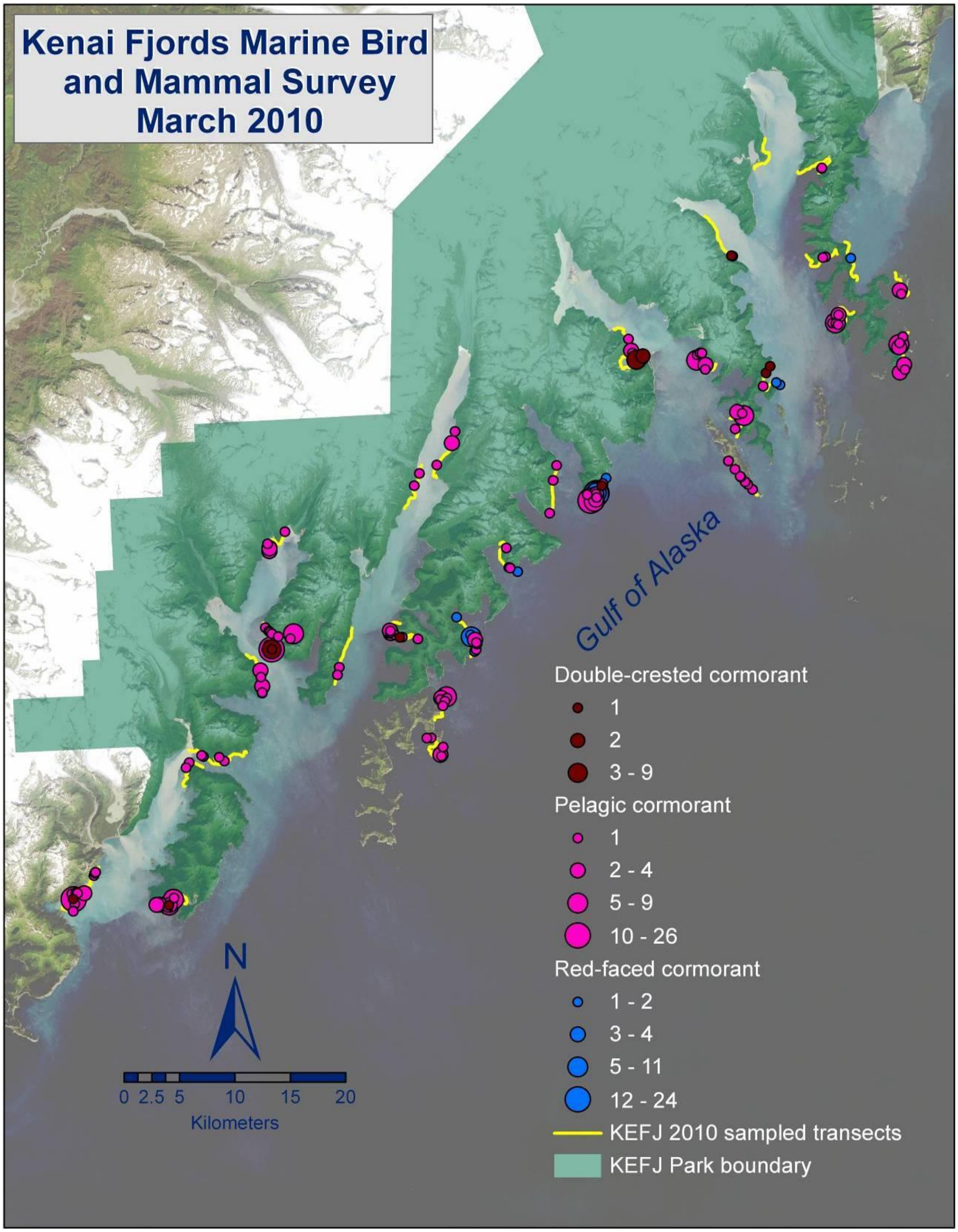

Figure 6. Cormorant relative abundance and distribution along the KEFJ coastline, March 2010.

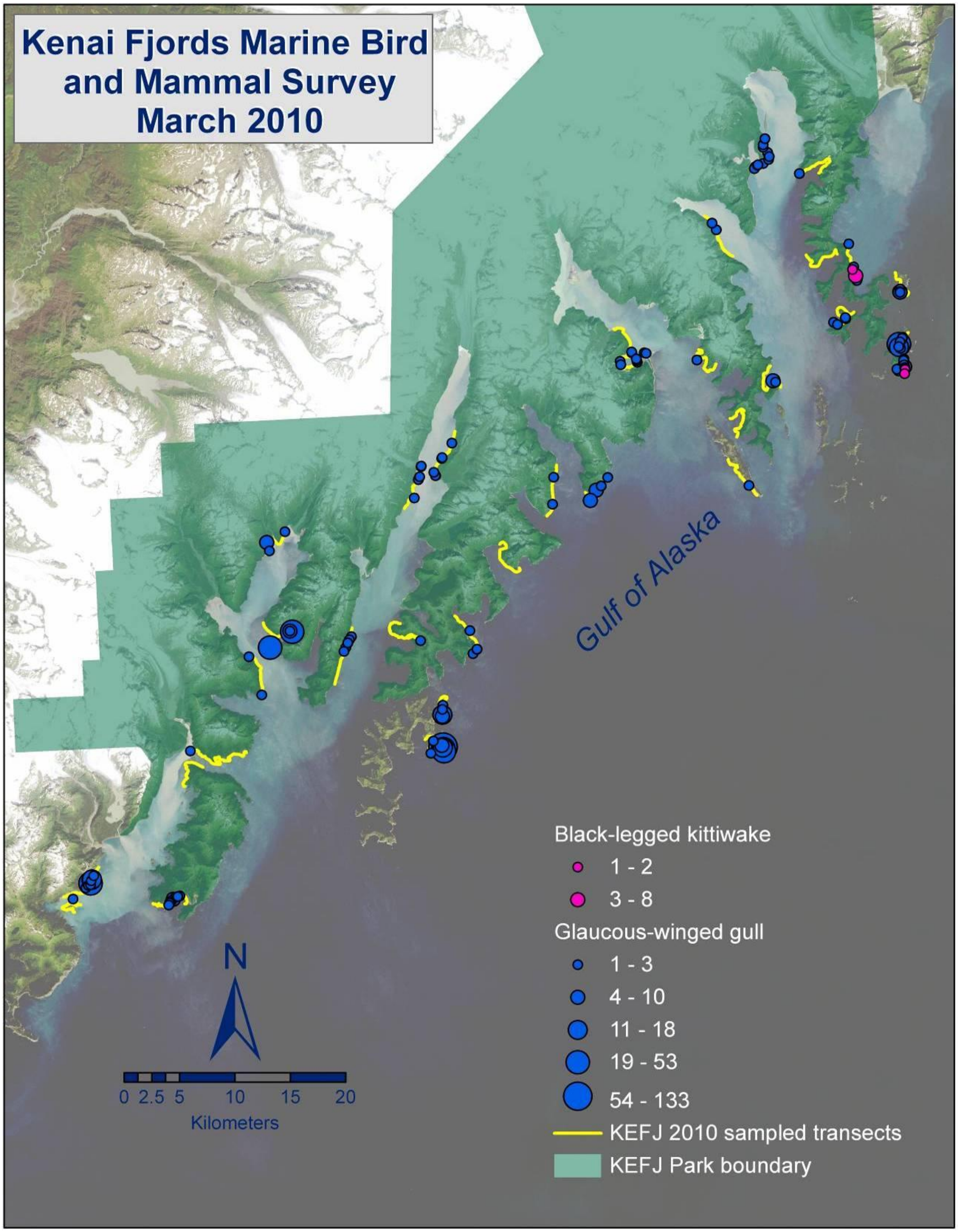

Figure 7. Black-legged kittiwake and Glaucous-winged gull relative abundance and distribution along the KEFJ coastline, March 2010.

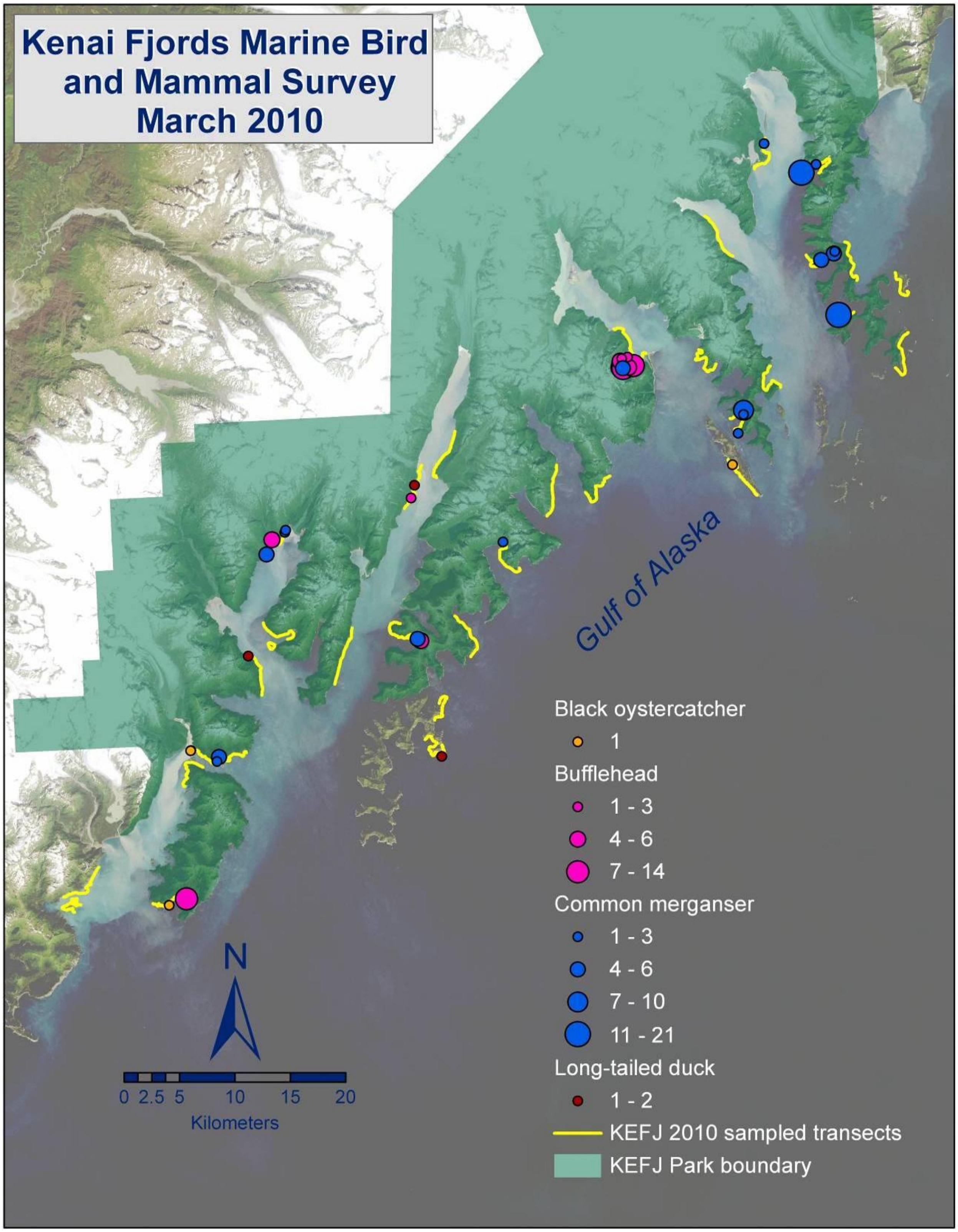

Figure 8. Black oystercatcher, bufflehead, common merganser and long-tailed duck relative abundance and distribution along the KEFJ coastline, March 2010.

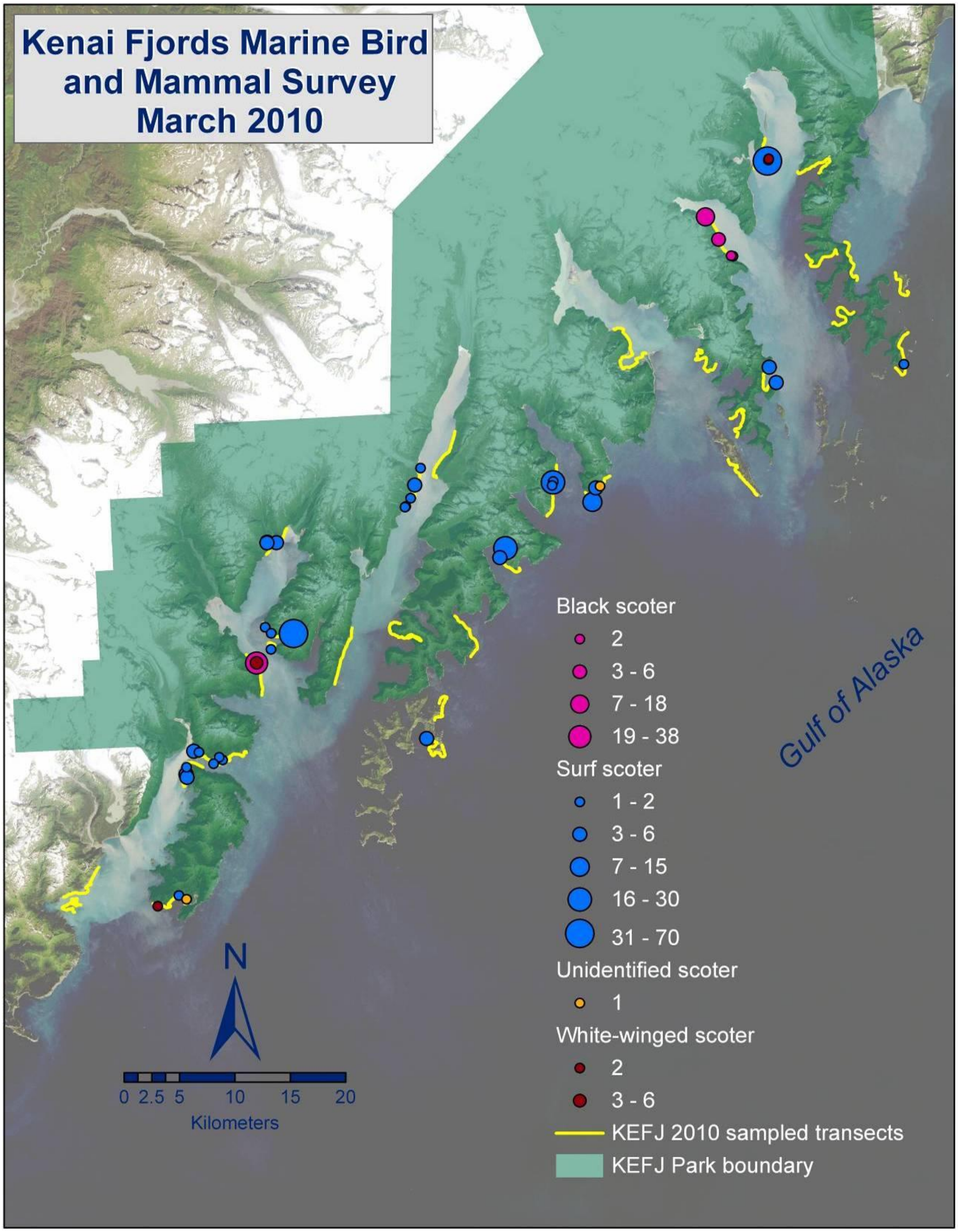

Figure 9. Scoter relative abundance and distribution along the KEFJ coastline, March 2010.

Discussion

Estimated nearshore densities of Barrow's goldeneye and Harlequin duck approximately doubled since our 2008 survey (Coletti et al. 2009). Barrow's goldeneye density was 12.44/km2 (SE=4.59) in 2008 and was 29.35/km2 (SE=9.24) in 2010. Harlequin duck density was 16.82/km2 (SE=1.75) in 2008 and was 29.30/km2 (SE=4.72) in 2010. Neither species exhibited changes in their general distribution from 2008 to 2010. This apparent doubling in estimated density may be a reflection of the interannual variation in the density of overwintering sea ducks and not necessarily a doubling of the population. The survey design SWAN is utilizing does not currently account for imperfect detection nor does it focus on any one species. Nor do we survey multiple times in a season to minimize intra-annual variation. Comparisons of results to the Vequist and Nishimoto report (1990) are difficult to make due to differences in survey methodology and data analysis. However, gross changes in some species' abundance may be determined with further work utilizing the Vequist and Nishimoto report (1990) and raw data from SWAN I&M surveys.

From preliminary analysis of data collected using the methods described in this report, the current survey design may be adequate for detecting trends for some species; however for other species power to detect change or trend may be relatively low. SWAN is planning to modify the survey slightly in the coming year to examine varying detection biases to determine effect on density estimates as well as measure covariates that may affect detection. Also, SWAN is anticipating the use of existing data in simulations, in a Bayesian framework, to estimate number of samples and sample frequency required to detect a specified trend or change with some level of confidence for selected metrics. Results may indicate the need for replicate sampling within a season as well as the need to modify the survey design to be species specific and based on habitat type to further minimize variation. Since some species overlap in their use of habitat as well as have similar distribution, a single survey design may be able to capture trends for several species and guilds within designated habitat types. This will lead to a better understanding of trends for specific indicator species across the western Gulf of Alaska.

Literature Cited

Andres, B. A. 1999. Effects of persistent shoreline oil on breeding success and chick growth in black oystercatchers. The Auk 116:640-650.

Coletti, H., J. Bodkin, T. Dean, and K. Kloecker. 2009. Nearshore marine vital signs monitoring in the Southwest Alaska Network of National Parks. Natural Resource Technical Report NPS/SWAN/NRTR—2009/252. National Park Service, Fort Collins, Colorado.

Dean, T. A. and J. L Bodkin. 2006. Protocol for Marine Nearshore Ecosystem Monitoring Southwest Alaska Network of National Parks. US Geological Survey, Alaska Science Center, Anchorage, AK.

Draulans, D. 1982. Foraging and Size Selection of Mussels by the Tufted Duck, *Aythya fuligula*. Journal of Animal Ecology 51(3): 943-956.

Esler D., T.D. Bowman, C.E. O'Clair, T.A. Dean, L.L. McDonald. 2000. Densities of Barrow's Goldeneyes during winter in Prince William Sound, Alaska, in relation to habitat, food, and history of oil contamination. Water Birds 23:423-429

Esler, D., T. D. Bowman, K. A. Trust, B. E. Ballachey, T. A. Dean, S. C. Jewett, and C. O. O'Clair. 2002. Harlequin Duck Population Recovery Following the Exxon Valdez Oil Spill: Progress, Process, and Constraints. Marine Ecology Progress Series 241:271-286.

Exxon Valdez Oil Spill Trustee Council. 2010. *Exxon Valdez* Oil Spill Restoration Plan: 2010 Update of Injured Resources and Services May, 2010. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska. 48 pages.

Hamilton, D., and T. Nudds. 2003. Effects of predation by common eiders (*Somateria mollissima*) in an intertidal rockweed bed relative to an adjacent mussel bed. Marine Biology 142(1): 1-12.

Irons, D. B., D. R. Nysewander and J. L. Trapp. 1988. Prince William Sound Sea Otter Distribution in Respect to Population Growth and Habitat Type. Prepared by Alaska Investigations Field Office (Branch of Wetlands and Marine Ecology) and Wildlife Assistance (Marine Bird Project).

Irons, D.B., S.J. Kendall, W.P. Erickson, L.L. McDonald, and B.K. Lance. 2000. Nine years of Exxon Valdez oil spill. Effects of marine birds in Prince William Sound. Condor:120:723-737.

Lewis, T. L., D. Esler, and W. S. Boyd. 2007. Effects of predation by sea ducks on clam abundance in soft-sediment intertidal habitats. Marine Ecology Progress Series 329:131-144.

Lindberg, D. R., J. A. Estes and K. I. Warheit. 1998. Human influences on trophic cascades along rocky shores. Ecological Applications 8(3): 880-890.

Marsh, C. P. 1986a. The Impact of Avian Predators on high intertidal limpet populations. J. Exp. Mar. Biol. Ecol. 104: 185-201.

Marsh, C. P. 1986b. Rocky Intertidal Community Organization: The Impact of Avian Predators on Mussel Recruitment. Ecology 67(3): 771-786.

Meire, P. M. 1993. The Impact of Bird Predation on Marine and Estuarine Bivalve Populations: A selective Review of Patterns and Underlying Causes Bivalve Filter Feeders in Estuary. In Bivalve Filter Feeders in Estuarine and Coastal Ecosystem Processes. Vol. G33 Heidelberg, Germany: Springer Verlag.

Peterson, C. H., S. D. Rice, J. W. Short, D. Esler, J. L. Bodkin, B. E. Ballachey, and D. B. Irons. 2003. Long-term ecosystem response to the Exxon Valdez oil spill. Science 302: 2082- 2086.

Springer, A.M. 1998. Is it all climate change? Why marine bird and mammal populations fluctuate in the North Pacific. P 109-119. In: G. Holloway, P. Mueller, D. Henderson (eds.) Biotic impacts of extratropical climate variation in the Pacific: Proceedings of the Tenth ‘AHA Huliko’a Hawaiian Winter Workshop, January 25-29, 1998. University of Hawaii at Monoa, School of Ocean and Earth Science and Technology, Honolulu.

Trust, K. A., D. Esler, B. R. Woodin and J. J. Stegeman. 2000. Cytochrome P450 1A induction in sea ducks inhabiting nearshore areas of Prince William Sound, Alaska. Marine Pollution Bulletin 40(5): 397-403.

Vequist, G.M. and M. Nishimoto. 1990. Seabird survey on the coast of Kenai Fjords during the *Exxon Valdez* Oil Spill. Natural Resources Final Report AR_90/04. National Park Service.

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NPS 953/107696, May 2011

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